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Cooperrider,
C. K.

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THE WILD GUAYULE SITUATION IN MEXICO

A Preliminary Report for Emergency Rubber Project

U. S. FOREST SERVICE

by

C. K. Cooperrider and Matt J. Culley

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November 7, 1942

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EXPLANATORY STATEMENT

This preliminary report is made now to supply advance information. It is confined to presentation of data on the quantitative appraisal of wild shrub and such related information as may facilitate understanding and action affecting the production of guayule rubber in Mexico.

The data for parts of the State of Coahuila are incomplete, the investigation being temporarily discontinued in the general Cuatro Cienegas area during a wet weather period that made adequate examinations of country impossible. Field work will be resumed about November 10; it will give more attention to problems such as guayule cultivation and will be completed after about 6 weeks. A final report, including complete data on the State of Coahuila, photographs, greater detail, and additional discussion, will be prepared following return of the field party to the United States. The additional information obtained may allow for better check of data or even modify somewhat the results given in this preliminary report.

SUMMARY

1. Guayule occurs in patches as foot-slope, foothill growth on widely scattered mountains. Mountainous areas with guayule constitute about 15 percent of total area and of such mountainous areas, only about 10 percent have guayule growth.

2. Most of the guayule lands are in private ownership; public lands are practically all agrarian lands, or ejidos.

3. Estimate of merchantable shrub in the five States of Chihuahua, Durango, Zacatecas, San Luis Potosi, and Nuevo Leon is 154,000 metric tons; and for the State of Coahuila a theoretical calculation results in 100,000 metric tons; or the possible total for Mexico is 254,000 metric tons, more or less.

4. Guayule processed by the four mills in Mexico had reached, as of September 1942, about 180 metric tons of shrub per day, 24-hour run; planned production on the basis of feasible mill additions is estimated at 240 metric tons of shrub per day.

5. On the basis of milling 240 metric tons of shrub per day, the estimated shrub supply of 254,000 tons would constitute about 3 years' run.

6. The guayule rubber processing is a rather highly specialized industry, particularly as to field operations. The time required for organization of effective field and mill operation is an important factor affecting possible increases in rubber production through new processing plants and during the next 2 years.

7. Overdevelopment, as compared with orderly development, of the guayule industry and resulting destructive competition and practices may result in decreasing rather than increasing total rubber production during the war emergency.

8. Export of shrub for milling in the United States is considered impractical and undesirable.

9. Guayule companies operating in Mexico have rather ambitious plans for cultivation of shrub; they should be vigorously encouraged. The prospects for extensive and successful cultivation of guayule in Mexico seem favorable; they should be further investigated.

CIRCUMSTANCES AFFECTING THE INVESTIGATION

Purpose

The investigation was undertaken in order to obtain first-hand information on the guayule situation in Mexico. It was aimed initially toward determination of the approximate amount of wild shrub, and in turn the possibilities of increasing the rubber supply for the war effort through means such as greater output of operating processing plants and construction of new plants. Numerous promotion schemes, involving shipping of shrub to the United States for processing, also have been advanced from time to time.

History of Survey

The survey of distribution and growth stand with estimates of amount of guayule began in the Big Bend region of Texas in April 1942, was extended to Mexico in June and continued throughout the summer. The work in Mexico followed an investigation and report on the guayule rubber processing industry and its potentialities made by O. D. Hargis for the Bureau of Plant Industry.

Factors Affecting Field Work

Considering the character and common lack of transportation facilities, as roads, the country observed embraces a tremendous area to be covered during any short period of time. Travel was by automobile and on foot from places reached by car. Field camps were pitched wherever convenient and at new locations each night. The summer season (the rainy period) proved to be unfavorable for any such field undertaking. Had it not been a very dry summer and had not the period of examination of many areas coincided with dry periods, the work could not have been carried out. Topographic maps of the strip, air flight type, were used in the field; without them, travel could

have been neither successfully nor safely directed. Safeguarding health, even the obtaining of food, gas, and water, sometimes were serious considerations.

The generous spirit of cooperation extended by individuals of the rubber processing companies was an encouragement as well as an aid; it made for most effective use of limited time. We also wish to acknowledge the valued assistance rendered by members of the United States Diplomatic Service and by officials of the Republic of Mexico. Individuals in all parts of the region, some of them land owners, many of them laborers in guayule camps, supplied valuable first-hand information. To the many we troubled with questions, to those who kindly gave us directions, saw that we found gas and water and food and shelter, and to those unknown persons who befriended us in divers ways, we extend our thanks in appreciation.

Methods of Approach

Methods of approach may be considered as indirect and direct. The indirect include (1) interviews with officials of companies engaged in harvesting and processing guayule shrub who supplied data on location and character of shrub stands and information on the industry in general; (2) interviews and field trips with employees located at the four plants, and the many field camps and shipping stations of the processing companies, and (3) contacts with local residents throughout the guayule region.

The direct included (1) examinations to determine the exterior boundaries of the guayule country and the extent of different guayule-bearing lands within the boundary of the plant's range. (Some considerable effort was expended on such determinations in order to test the validity of the many claims reaching official United States of vast undeveloped sources of shrub,

some beyond what has been believed to be the range of guayule, some in little-known and undeveloped areas, and some on public and private lands not covered by contracts for purchase and others contracted for and owned but held unharvested.) (2) Survey of local guayule-bearing areas to determine the extent of each, part of each having shrub, and character of stand, including estimates of average amount of shrub. (In such appraisals, sample plots, transects, and like methods were used in sampling. In some places the number of individual plants on sample areas were counted, and in others, plants of merchantable size were pulled and weighed. Data so obtained were used as a guide in making ocular estimates.)

APPRAISAL OF WILD GUAYULE SHRUB

The data in table 1 present the results of the appraisal of shrub for the five States of Chihuahua, Durango, Zacatecas, San Luis Potosi, and Nuevo Leon and a theoretical calculation for the State of Coahuila. The calculation for Coahuila is based on comparison of conditions on the parts of that State and other States examined with conditions as indicated by topographic maps, etc., for the areas as yet unexamined, and is tempered by information obtained locally.

Table 1.--Estimates of guayule shrub of merchantable size in the States of Chihuahua, Durango, Zacatecas, San Luis Potosi, and Nuevo Leon with theoretical calculation for the State of Coahuila

Regions 1/	State	Amount of shrub (Field weight) Metric tons 2/	Theoretical calculation Metric tons
1	Chihuahua	15,550 18,500	---
2	Durango	54,700 49,900	---
3	Zacatecas	57,950 55,500	---
4	San Luis Potosi	15,500 14,300	---
5	Nuevo Leon	17,300 16,300	---
6	Coahuila	Incomplete 73,000	100,000

Total for 5 regions - 154,500. Total including Coahuila - 254,500.

1/ Areas designated on map, fig. 1.

2/ Metric ton (2,204.6 lbs.) the unit of mass weight employed in Mexico.

Factors Affecting Estimates

Although the natural habitat of guayule embraces a large part of the Plateau of Northern Mexico, a glance at figure 1 indicates the relatively small amount of that part that is guayule land. Furthermore, on guayule land (shaded areas on map), the plant grows only in scattered patches, some less than one, others of several hundred acres. There are no large, continuous stands.

Land area has little significance as to amount of shrub, be the unit under consideration the area embraced in the plant's range, the area of guayule land, or the area in some specific ownership. The area in the plant's range may be considered to vary with variation in regularity of the exterior boundary enclosing all the widely separated guayule lands (fig. 1). On the basis of the area investigated, about 15 percent is guayule land, and of that, slightly less than 10 percent (shaded areas, fig. 1) actually had guayule, or about $1\frac{1}{2}$ percent of "guayule land" bears any merchantable quantity of the plant. But knowing the land area with shrub is only one factor in determining the amount of shrub.

The density of stands and size of plants vary greatly under natural conditions, both factors are believed to have been greatly affected by degree and frequency of past cuttings. Sampling results indicated variations of from a few pounds to as much as 2,700 pounds per acre. Such samples and the estimates in table 1 include only plants of merchantable size. Mexican law, which by the way applies to all lands, designates merchantable size as anything above 2 cm. main stem diameter or, as translated for the field worker, nothing smaller main stem diameter than the shank of the thumb.

The above and many other facts illustrate the difficulties of estimating. Exterior boundaries of areas with shrub were delineated according to

topographic maps of 100-meter interval. This could be done with reasonable accuracy because of the topographic detail for mountain areas and in turn because guayule is a footslope, foothill growth. It was not found in the valleys or on any deep-soiled, gently sloping lands.

The inventory was obtained by applying to guayule lands an estimate of the percent of area with shrub and of the pounds per acre. Percent of area with shrub varied from 6 to 12 and pounds per acre ranged from 400 to 675. Both are averages for large areas or regions. Any estimate involving so many variables may involve considerable error.

In earlier harvestings, some shrub of marketable size is commonly left in places because of factors, such as degree of accessibility, affecting harvesting--for guayule cutters are paid on the basis of tons pulled and not by the day. Some shrub in any locality may be considered inaccessible at some particular time because of steepness of slope, packing distance to camp, distance to water, lack of laborers in the area, and like factors affecting harvesting. The influence of such factors is not a constant and hence was not taken into account in estimating shrub.

The average difference between available, marketable shrub and harvested shrub may be as much as 10 percent for areas more or less consistently worked, however this is but a guess. In general, the more accessible by road and rail the area is to the processing plant, the longer the plant has operated, and the better the desert labor supply in the field the more thoroughly the area has been worked.

The four plants now operating are either old plants or near the location of former plants. A number of other widely scattered plants have operated in the past. For example, one of these defunct mills was located at Monclova.

Here shrub from roundabout Cuatro Cienegas and north toward the United States border was processed during the last war. This area now is distant from any processing plant. Apparently almost every part of the country, excepting northern Chihuahua (small areas in the northern part of region 1, fig. 1) and the part of Coahuila just south of the United States border have been worked over some period during the last 35 years. Some areas have been harvested again and again.

Factors Affecting Shrub Supply

The estimates of the amount of guayule are of shrub of merchantable size. Whether conditions are favorable or unfavorable to the growth of small, well-established plants to marketable size, seedling growth, and the like, may materially affect the supply of shrub during the next few years.

The indications are that the natural stand has declined materially since processing of shrub began. This seems particularly evident in marginal growth zones and on poorer sites and in some of the areas harvested again and again. On the other hand, some favorable growth areas that have been worked periodically for many years still have good stands; however, such stands may have been more extensive and of better density formerly than now. The prevalent, but not unanimous, opinion of those in the industry is that they were and that the days of any extensive operations dependent alone on wild shrub are numbered.

There is much to indicate that guayule stands may suffer greatly through loss of plants and poor growth during periods of excessive drought and that rapid growth and regeneration take place during favorable growth periods; whether the next few years are highly favorable, average, or very unfavorable may be expected to materially affect the amount of shrub available during the same period and particularly what may be left to tide over

the period of establishment of the budding new industry--production of cultivated shrub on plantations.

Sufficient evidence of extensive recent and old burns and the resulting damage was observed to indicate that fire could materially affect the supply of shrub on which some mills are dependent.

Other factors, as goat grazing, doubtless have had an effect; however, it seems likely that damage from such sources may be of more importance in the long run than of material significance during the period of the emergency.

No evidence was encountered to indicate that insects or disease are likely to jeopardize the present shrub stand.

GUAYULE RUBBER INDUSTRY

There are two companies processing guayule rubber in Mexico--the Continental Mexican Rubber Company and the Cia. Hulera de Parras. Continental operates three mills (fig. 1), one each at Torreon in the State of Coahuila, Cedros in the State of Zacatecas, and Catorce Station in the State of San Luis Potosi. They have processed rubber at these places or nearby more or less continuously for the last 30 to 35 years. The fourth mill is located at Parras in the State of Coahuila. This also is an old milling site where the Madera family were early processors. The company was re-organized and the mill reconditioned during recent years.

The following brief and popular account is given to aid in the understanding of the industry.

Shrub Contracts

Most of the shrub is bought as a wild land crop through contracts with private land owners. Some comes from public land (largely communal agrarian lands or ejidos), some from company-owned lands. Individual contracts usually are for a period of years and harvesting may take place during any period or

extend through the period of the contract. Contracts are commonly renewed on expiration.

The contract price is on a per ton (metric) basis, dry weight of baled shrub, and varies with fluctuations in the market price of rubber. To illustrate, for each 1 cent (U. S. currency) the value of rubber varies above or below 14 cents, New York market, the price paid for shrub varies 1 peso plus or minus per ton, with a guaranteed minimum of 7 pesos.

Continental Company does practically all its own harvesting and transporting of shrub to rail point and factory. Parras Company contracts for rail point and factory delivery.

Field Labor

The contracting party commonly supervises the harvesting, drying, baling, trucking, and shipping of shrub. However, the fact that labor for the harvesting operation is recruited from local residents and that they are few in number, but the only people adapted to living and working in the peculiar desert environment, makes the industry highly dependent on such labor. In fact it is commonly said that it is useless to consider recruiting labor from the city and other rural districts because of the requirements of the job and living conditions in the desert.

These people live in villages located about water holes in the desert and under conditions somewhat similar to United States desert Indians like the Papago and Hopi in Arizona. They farm small patches through flood run-off irrigation and are largely self sufficient. Many of them work year long in guayule but less or not at all during planting and harvesting periods. These same villagers sometimes gather and refine candelilla¹ shrub for wax and gather and process yucca for fiber from which they make rope, webbing, sacking, and nets. Since some former sources of wax are cut off, the candelilla¹ industry competes with guayule for labor, sometimes disastrously.

Harvesting

Guayule harvesting is done from village bases and temporary camps. Water supply decides the location of most camps, but water and other camp supplies for pack burros and men is sometimes hauled as much as 50 miles over improvised truck trails.

In harvesting guayule, the pickers pull the shrub, roots and all. They then tear apart the larger branches for close packing, tie the shrub into bundles, and pack it into camp on burros, 2 to 3 bundles to the animal. Pack hauls are made up to 7 or 8 kilometers, or about 5 miles, loads on shorter packs commonly approach the weight of the pack burro. On arrival at camp, the shrub is weighed on steelyards and spread on the drying grounds. Pickers are paid according to weight of shrub delivered at the camp.

Transportation

When dried so as not to mold in the bale or to meet storage or milling needs, the shrub is baled in hand presses and tied with hay wire. It is then ready to be trucked to railroad and factory. Bales weigh about 100 kilos, commonly run about 210 to 220 pounds.

From the field camp, guayule is trucked to rail point and factory. Extreme truck hauls are as much as 100 miles and similar rail hauls, 300 miles. Of the four factories, the largest receives all shrub by rail and the smallest, nearly all by truck and the remainder by mule team and oxcart. Transportation is greatly affected by rough, wheel-rutted roads that are deep with dust when dry and become impassable mires when wet. Factories, railroads, and main roads are shown in figure 1.

Milling

Shrub gathering and milling ordinarily go on year long. Less shrub is gathered during the season the workers plant their fields and hauling is

sometimes seriously hampered during wet weather in summer and fall. Provision is made for both of these handicaps through increased harvesting in the spring and storage of baled shrub in thick-walled, heavily insulated warehouses located at the factories.

Mill recovery of rubber depends on a number of things, including degree of perfection of mill operation, kind of shrub, period of the year shrub is gathered, and condition of shrub when milled. Quotations on rubber recovery vary so much as to be confusing. This may be accounted for in part through the basis of the estimate, whether a percentage of actual dry weight of shrub, weight of baled shrub when milled, which varies, or baled weight of shrub when purchased f.o.b. railroad. Possibly purity of product may be an item. The impression was gained that about 14 percent may be considered average recovery from cured, baled shrub; however, estimates as low as 8 percent are sometimes reported and data on period runs averaging over 18 percent have been quoted.

It is commonly agreed that other things being equal, shrub mills out the best when harvested in winter and spring before growth begins and returns the least rubber at the end of the growing season. Moldy shrub is said to have poor rubber content.

Milling shrub at the right stage of dryness seems to be one of the most important considerations. Experienced mill men apparently are able to judge proper condition. When shrub is milled too green or not properly cured, the recoverable rubber, which occurs in all parts of the plant save the leaves, tends to adhere to the wood fiber, and when too dry the rubber particles disperse. Both conditions hinder recovery. Mechanical dryers are being installed at the Torreon and Cedros plants.

The milling employed in processing guayule rubber is a mechanical process. It is predicated on the occurrence of guayule rubber in free state and not in latex form, as in the rubber tree. The principal steps in the operation, beginning with the chopping of the shrub and ending with the boxing of crude for shipment, are: (1) crushing and mangling between pairs of heavy, rough-surfaced rolls; (2) introducing hot water to crushed shrub conveyed from roller mills; (3) reducing sludge (mangled shrub in water) in tube and ball mills similar to those used in cement and ore reduction plants; (4) separating and collecting (in large flotation tanks) rubber and cork--both float--from wood pulp which became waterlogged in the tube mills; (5) separating rubber from cork, which is done by first waterlogging the cork in pressure tanks and then separating floating rubber from waterlogged cork in flotation tanks like in the fourth step; (6) washing by first putting concentrate through small ball mill and then washer to free adhering cork and fiber; (7) drying and processing, by which the loose, spongy, curdlike, green mass is first run over a jig box and through a press to rid it of excess water and then baked under part vacuum to facilitate the extracting of moisture; and (8) pressing and packing the now black, water-dry product into 100-pound cakes and boxing for shipment. The factory product is crude, nonderesinated rubber; there are no deresinating plants in Mexico. Resin and impurity content of crude is said to run from 15 to 20 percent by weight.

There are two types of mills in operation, the tube and the batch. The tube provides for continuous flow through tube and ball mills and flotation tanks; the batch is essentially a battery of many individual, short tubes each of which is charged separately with a batch of crushed shrub, water, and ball. Quartz pebbles are employed in both types of mills, the pebbles being discarded when reduced to about chicken egg size. Continental Company mills are all tube; Parras uses the batch system.

RATE OF PROCESSING GUAYULE

Of the four mills in Mexico, three operate 24 hours (three shifts) per day and 7 days per week; the fourth mill works 6 days per week. They are processing, as of September 1942, about 180 metric tons of shrub per day, or producing between 50 and 60 thousand pounds of crude daily.

Potential capacity at the four locations is estimated at about 240 metric tons. This estimate is based on statements of the operators, knowledge of the mills, and other evidence, including the following:

(1) Continental Company has done much remodeling of plants during the last year. They have three tube mills in warehouse, replacement stock at Torreon that could be used for factory addition. (2) Parras Company was building a new power house for which they had the machinery. This new plant was estimated to make available 40 to 50 percent more power than is necessary to run the present factory; it should be completed in December of this year. This extra available power could well be used to operate additional processing units. Insofar as is known, such units must be found and purchased.

The manager of the Parras Company expressed his desire to increase plant capacity as soon as possible after United States policy was known--the "Rubber Agreement" with Mexico was then (August 1942) pending--and provided he could contract the shrub. The Parras Company has been busy reconditioning an old plant and reestablishing the business. Mr. Baker of the Continental Company again and again expressed the attitude of being willing to cooperate in any manner in realizing additional rubber supply.

Both of these companies were negotiating throughout the summer for shrub controlled and held for speculation in the general Cuatro Cienegas area of the State of Coahuila. If successful, they expected to divide the purchase.

A number of other interests were after the same shrub as a basis for forming a new company and construction of a new mill. The outcome of such negotiations is understood to be still pending (October 1942).

At the estimated potential mill capacity of 240 tons per day, some 85,000 tons of shrub would be processed per year. On the basis of the figures in table 1 and provided the shrub could be contracted, harvested, and delivered, mills could run about 3 years. It seems more reasonable to suppose that production may be built up to a peak in 1943 and decline sometime during or after 1944, but last on a substantial basis for 4 to 5 years. Such an assumption takes into account reasonable elements, including the following: (1) the time necessary to attain peak production; (2) time to obtain contracts and organize new field operations in areas remote from water and rail points; (3) available experienced field labor, problem of new laborers, and competition for labor with other industry, as candlelila wax; (4) transportation, including availability of railroad cars, trucks, tires, and effect of unfavorable weather; (5) maturity to marketable size of shrub on areas cut during recent years but that may be reworked during the next 4 to 5 years; and (6) the assumption that harvesting would be pushed into remote areas now having large shrub as soon as possible, so providing small plants on recently pulled lands the opportunity to gain better than marketable size and be harvested within the next 4 to 5 years.

OTHER PROPOSALS FOR INCREASING RUBBER SUPPLY

Increasing rubber production through further increasing mill capacity of processing plants now operating has been discussed. Other proposals that have come up are (1) the purchasing and exporting of shrub from Mexico for milling in the United States, and (2) the encouraging of construction of new mills at some favorable location in Mexico.

Importing shrub to the United States has had but one favorable aspect, namely the degree to which it might make more rubber available, and that was not encouraging. When such export propositions first came to the front early this year, the only mill in the United States was located at Salinas, Calif., over 1,000 miles from any port of entry where guayule might come in, and that mill was small.

The merit of construction of new mills in the United States depended mainly on the availability of supply of shrub in Mexico for export, and the importance of insuring delivery of processed rubber through milling in the United States. It soon became evident that the obtainable supply of shrub was small, and now that the Rubber Agreement between the United States and Mexico has been consummated, any argument for milling in the United States to assure delivery of rubber seems weak.

Perhaps a few of the factors affecting the importing of shrub into the United States should be mentioned, namely:

1. Exporting of shrub is looked upon unfavorably by the Government of Mexico.
2. Effect on processing companies now located in Mexico and who are being encouraged to increase production that entering into competition with them for shrub they need would have.
3. Cost of shipping, fumigation of shrub at United States border, etc., particularly the cost entailed by any long haul, as to Salinas, Calif., and the cost, considering the small amount of rubber involved.
4. Transportation. Railroads are overtaxed and guayule is a bulky cargo, the bulk capacity of a load of guayule being less than one-half the weight capacity of a box car.

5. Likelihood of long hauls through hot country resulting, except possibly in winter, in overheating and excessive drying of shrub, and consequently in low recovery of rubber on milling.

As to the second proposition, namely encouraging construction of new mills in Mexico, the only considerable part of the guayule country that may be considered to be more or less undeveloped and the only relatively large body of shrub controlled by interests other than the present operators is located in the northern part of the State of Coahuila. Until more is known about the prospects in northern Coahuila, data are lacking on which to determine the need and effect of a new mill in that area.

If the theoretical estimates for the Coahuila country concerned are reasonably correct and if most of this guayule was obtained by a new operator, the shrub would support a small mill for a relatively short time run. Present processing companies now operate extensively in the western and southern parts of Coahuila. Should the undeveloped areas not adequately support new operations and the old companies be cramped for shrub to meet the demands of increased production programs, competition between new and established operators may develop throughout other districts as well as the Cuatro Cienegas area, and in turn may result in hindering rather than facilitating production of rubber and also hinder development of cultivation programs.

On the other hand, location of a small mill somewhere in the northern part of Coahuila might eventually stimulate production, particularly if the operation were confined to that area and development of plantations went hand in hand with mill establishment.

From the standpoint of location, Monclova seems to be a favorable site for a mill; whether there are lands suitable to cultivation in this area is

not known. Operating companies claim to have investigated mill possibilities here and to consider it more economical and feasible to ship the shrub to present processing plants. This they are now doing to some degree.

Rail transportation facilities are shown in figure 1. In milling at Monclova, shrub doubtless would be shipped from 30 to over 100 miles by rail if field operations were confined to northern Coahuila. Shipping distances from the same country to present mills may be judged by the approximate mileages from Cuatro Ciénegas as follows:

To Parras	-	225 miles
To Torreon, via Escalon	-	275 miles
To Torreon, via Monclova	-	325 miles
To Catorce, via Saltillo	-	290 miles

Field operations and developments necessary for delivery of shrub to rail points would be the same wherever the shrub was processed.

CULTIVATION OF GUAYULE

There are no guayule plantations in Mexico. The Continental Company has conducted experiments both in Mexico and the United States. They established a nucleus nursery in the summer of 1942 and are investigating several plantation locations. The Parras Company is also planning a plantation program. The prospects for successful cultivation of guayule in Mexico seem to be favorable; they should be systematically investigated.

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Preliminary Statement

During the period of the investigation on the wild guayule situation in Mexico, informative memoranda were submitted from time to time. The preliminary report of November 7, 1942, to which this report is supplementary, was made prior to completion of initial phases of the investigation. The authors of such memoranda and reports entertained the hope that the essentials of all such material might be brought together in a comprehensive report following completion of the field investigation. Immediate demands for initiating other investigations in Mexico and for supplying data pertaining to specific problems make realization of such a hope impossible at present.

As regards data on specific problems, the most urgent present need seems to be for information on the merchantable supply of guayule in Mexico and the likely means of processing it to best meet emergency needs for rubber, and in so doing to effect the most purposeful use of materials employed in rubber processing but also vital to furthering other war efforts.

The Problem

In the beginning two primary aims of the investigation were to obtain unbiased information on (1) the presence or the lack of important undeveloped and unused supplies of guayule shrub and (2) the degree to which operating companies and mills were and could process the available shrub, and hence the possibilities of increasing rubber output through increasing the output of existing mills, through new mills, and also through exporting shrub for processing in the United States. The picture, or the conception of it, has changed materially since then. For one thing, the rubber agreement with Mexico more or less nullifies the need for further efforts to insure delivery of rubber to the United States, as through importing shrub. For another

thing, the impression was had in the beginning that the processing of the available shrub supply during 1943, 1944, and 1945, through a program co-ordinated with the development of synthetic supplies, would result in the best use of this small rubber resource, as compared with the more rapid exhaustion of it, even if such were possible before synthetic in quantity is available. Also that such orderly processing would allow the companies to transfer gradually from the use of wild to the use of cultivated shrub, and hence act as a stimulus to rapid and extensive development of plantations with the end result of making more rubber available.

At present the aim seems to be to obtain all the guayule rubber possible during 1943 and early 1944, or within the next 18 months to 2 years. Such a program of total harvesting over so short a period eliminates the possibility of giving consideration to regrowth on large areas of cut-over lands, and it demands practical consideration of what is possible—not only what it is possible to mill, but also what it is possible to harvest.

The established industry reaches into almost every part of guayule land. It is operated on the basis of cutting cycles of 5 to 10 or more year intervals between cuttings and it is organized to mill year long, which necessitates meeting seasonal conditions as that during the annual rainy season when transportation by road may be seriously affected. The shrub is obtained very largely through contracting with private owners.

For these and many other reasons, the quantity of shrub in Mexico, whatever it is, should not be considered as a field crop available for the harvesting or as a given tonnage to be run through a mill, but as a wild crop, the gathering of which depends on so many uncertain factors that some considerable part may never be secured during any short period of time.

Inventory of Wild Guayule Shrub

In the report of November 7, 1942, is listed in table 1 the inventory of shrub for five States and a theoretical calculation for the State of Coahuila, which had then been worked only in part. These data were not materially changed by completion of the field survey and subsequent compilations, except for the 100,000-ton theoretical calculation for the State of Coahuila, which was too high.

The northern part of the State of Coahuila, or the Cuatro Ciénegas area, is attracting particular attention; it involves the only large areas from which shrub has not been harvested in recent years. A considerable amount of this good shrub is controlled by one individual and is held for speculation. Negotiations to obtain it by present and prospective processors have attracted so much attention that the problem of the Cuatro Ciénegas area tends to obscure other less publicized problems affecting guayule rubber production.

In order to better show the relation of amount and location of shrub to the present guayule processing industry and to any proposals for further developments, guayule land has been divided into three regions, as shown on the attached map (fig. 1). The data on amount of shrub are similarly shown in table 1 of this report.

Table 1.—Estimate of merchantable shrub			
: Amount of shrub, metric tons 2/			
Region 1/	: Accessibility : Fair to good 3/	: Scattered 4/ : Accessibility poor:	: Total by Regions
1	164,575	25,675	190,250
2	35,025	4,250	39,275
3	22,650	7,020	29,670
Totals	222,250	36,945	259,195

1/ Areas designated on map, fig. 1.

2/ Metric ton (2,204.6 lbs.), the unit of mass weight employed in Mexico.

3/ Of a character and location usually harvested in normal times.

4/ Widely scattered patches, poor stands, unfavorable terrain, areas lacking camp water, long and difficult road hauls from areas with small amounts of shrub.

Basis for regions

Two of the regions are areas tributary to existing guayule rubber mills. The third, the Cuatro Ciénegas-Monclova area, is the principal area under consideration for location of a new mill. The boundaries of any tributary area are arbitrary lines influenced primarily by developments or probable development of the industry, which in turn is affected by the location of rail and road transportation facilities, water for men and pack animals in field camps, field labor supply, purchasable shrub, shrub readily accessible to rail points and for emergency use as during the rainy season, and by land relief, relative accessibility, and purely business reasons.

The influence of industrial development accounts for Region I including the three mills and most of the extent of operations of Mexican Continental Rubber Company, and Region II, that of the Cia. Hulera de Parras. However, it is impossible to show more than the general picture because each of these companies has contracts and harvests more or less shrub outside the region where its mills are located. To illustrate, the Continental Company is known to have rather extensive contracts and field operations in Region III in the general vicinity of Ocampo and the Parras Company to have contracts in Region I. In this connection, cooperative practices of the two competitive processing companies, such as exchange of shrub contracted in Continental territory by Parras for shrub contracted in Parras territory by Continental, and vice versa, has done much to assure economic development. The boundaries of any region are not static but tend to change from time to time with the making of new and closing of old contracts with land owners. For the same reasons, the estimated amount of shrub within any region, as shown in table I, is indicative only of the supply available to the company doing business mostly in that region.

Factors affecting shrub estimates

In areas as Region I where operations have been more nearly stable and continuous for many years, harvesting tends to follow cutting cycles. That is, areas cut over any one year become essentially unproductive sources of shrub for some years to come, but are potential cutting areas of the future. Theoretically and under ideal management and some sustained level of processing, the amount of shrub coming into production each year would equal the shrub cut that year. As a matter of fact, conditions as lack of control of land, fluctuation in volume of shrub processed, and variation in rate and amount of regrowth greatly affect the situation.

Although the influence of cutting and regrowth on current supply of shrub was recognized, it was considered inadvisable to attempt to locate and untangle the maze of different aged cuttings in Regions I and II--the situation is too complicated and total area too large. Conditions are somewhat different in Region III. Here recent cuttings may be segregated because many years have elapsed since the now dismantled, local mills were in operation and extensive harvesting was done. They are shown (map, fig. 1) in double cross hatch and include stands so thin and scattered as to be unmerchantable both because of natural conditions and past destructive practices. They were considered to have little or no practical value during this emergency period.

Accessibility

The data on amount of shrub (table 1) are rated according to relative accessibility; the more accessible amount is shrub that would usually be harvested in normal times. It is most likely to be taken first now.

The less accessible tonnage constitutes the shrub in widely scattered, small patches, the thin stands, and that where relief, terrain, water, and transportation are unfavorable. It should not be counted on too strongly

under any short period program of total harvest, even under present conditions of high rubber value. Some type of subsidy may be necessary to assure the obtaining of much of it, particularly now that Mexico has placed a harvesting tax on guayule.

Rate of Processing

Although up-to-date information is not available for all mills, it is believed that the rate of processing as of January 1, 1943, has reached about 210 tons of shrub per day. This represents an increase of about 30 tons per day over the amount (180 tons per day) given in the report of November 7, 1942.

Possibilities for Further Increasing Production

The figures given above on current production and the data on amount of shrub supply in table 1 of this report do not materially change the picture presented in the report of November 7, 1942, particularly as it concerns the aim of obtaining all the guayule rubber possible during the next 2 years.

The report of November 7, 1942, indicates the possibilities of increasing rubber production through increasing the capacity of existing mills and through new mills. It also shows that any shrub that may be processed at a new mill could be processed by the present mills.

In order to show the significance of the data on the available amount of shrub and the merits of proposals for converting it into rubber in the shortest time and with the least consumption of strategic war materials, guayule land has been broken down into the regions shown on the map (fig. 1) and in table 1.

Region I

In Region I the present rate of milling of 150 tons of shrub per day amounts to about 52,500 tons per year on the basis of a 7-day week and a

50-week year operation. At 52,500 tons per year, the merchantable shrub supply (table 1) in Region I would be processed at the following rates:

1. More accessible tonnage (164,575 metric tons) 3.13 years.
2. Less accessible tonnage (25,675 metric tons) .49 year.
3. Total tonnage (190,250 metric tons) 3.62 years.

In any consideration of the above milling rate, certain facts previously stated in this report should be taken into account. They include the following: (1) Parras Company, operating principally in Region II, have some shrub contracts in Region I; the amount is unknown. They may be expected to make additional contracts. (2) Continental Company, operating principally in Region I, are known to have several thousand tons under contract in Region III, and may be expected to extend operations there. They probably obtain some shrub in Region II. (3) Region I includes scattered shrub patches at a great distance from any processing plant. Such patches may or may not prove practical to harvest.

Region II

In Region II the present rate of milling of 60 tons per day (this tonnage may be exceeded now) amounts to about 18,000 tons per year on an operation basis of 6 days per week and 50 weeks per year. At 18,000 tons per year, the merchantable shrub supply (table 1) in Region II may be processed at the following rate:

1. More accessible tonnage (35,025 metric tons) 1.94 years.
2. Less accessible tonnage (4,250 metric tons) .24 year.
3. Total (1) and (2) (39,275 metric tons) 2.18 years.

In considering the above rates of milling, the following should be taken into account: (1) Continental Company, operating principally in Region I, may have

some contracts in Region II. (2) Parras Company, operating principally in Region II, are said to have contracts in Region I but probably not to exceed a few thousand tons or little if any more than to match the tonnage controlled by others in Region II. (3) The north boundary of Region II was drawn to include some of the best old mature shrub south of Cuatro Ciénegas. Most of this country slopes to the south; the building of less than one-half mile of road through an area practically now impassable by car, would result in a more favorable truck haul to Parras (Region II) than to Cuatro Ciénegas (Region III); however, the shrub referred to is part of that held for speculation and is at present not available to the Parras Company. Without this shrub, the remaining tonnage in Region II is estimated to last the Parras mill only about 1 year.

Region III

There are now no mills in Region III. On a theoretical basis of a 40-ton per day mill or a capacity of 14,000 tons per year, the merchantable shrub would be processed at the following rate:

1. More accessible tonnage (22,650 metric tons) 1.62 years.
2. Less accessible tonnage (7,020 metric tons) .50 year.
3. Total tonnage (29,670 metric tons) 2.12 years.

Consideration of the above calculations should take into account the following:

(1) Region III includes small and scattered patches of shrub a great distance from any feasible mill location or railroad. (2) Continental Company is operating in this area. They claim to have several thousand tons of shrub under contract; they may be expected to contract additional amounts. (3) Considering (1) and (2) above, there is probably no more than about 1 to 1½ years' operation in sight for a 40-ton per day mill in Region III.

Probably the three most significant indications revealed by the regional analysis are:

1. The short period that advantage may be had of the milling facilities at Parras (about 1 year at the present rate of production) unless a large tonnage of shrub is obtained from outside Region II, or unless the shrub in Region II now controlled by others (probably 16,000 to 18,000 tons) is obtained for Parras mill, which would prolong life to about 2 years.

2. Region II offers the most favorable possibilities for obtaining shrub for lengthening the life or stepping up production of Parras mill. However, this Region could not supply large amounts of shrub to other Regions (it now exports to Region I) and also support even a small new local mill for any appreciable length of time.

3. The total amount of shrub in the three regions is too small to support any large increase over present production either through new mills or through increasing the capacity of existing mills. Also the prospects for increasing capacity of existing mills by adding some new units seems to be favorable from the standpoint of both time necessary to realize increased production and the relatively small quantity of strategic materials required. During the past year the operating companies have done much to improve their plants and increase production. However, they may be reluctant to further increase milling facilities unless they have assurance of the shrub to mill.

THE WILD GUAYULE SITUATION IN MEXICO
A Preliminary Report for Emergency Rubber Project
U. S. Forest Service

by
G. K. Cooperrider and Matt J. Culley

November 7, 1942

Supplement II

Photographic Story of Guayule Industry

February 20, 1943

*Photographs & descriptions with CKC's copy in
his file.*

February 20, 1943

A more or less casual knowledge of the guayule (Parthenium argentatum) rubber industry in Mexico might leave one with the impression that it consists of a series of simple, perhaps even antiquated, processes that require no great amount of skill or knowledge. Careful study, however, of the many and varied operations—beginning with the earliest step of locating the shrub as it grows wild in out of the way places through to the end where it finally comes out of the mill as processed rubber—brings one to a full realization of the fact that each separate operation requires a very definite degree of specialized knowledge and skill and that all phases must be closely coordinated in order to effect the most efficient production of rubber.

The first step in the industry involves location of the areas supporting guayule and not only determining the amount of the shrub that is available but also its probable rubber content. Years of experience alone enable the field man to accurately estimate the quantity of shrub on any given area and the probable percent of rubber that can be extracted from it. Following this comes acquisition of the shrub from the land owners. With but few exceptions, the guayule-bearing lands are in private or communal ownership and this entails dealing with a great many individuals, each of which involves an entirely separate contract. These contracts ordinarily cover a period of years and specify the period of cutting, the stumpage price to be paid, and often many other stipulations pertaining to the operation. Before these contracts can be finally consummated, the federal government—which controls all cutting of guayule whether on private or public lands—has to pass on them, stipulating the

maximum amount and minimum size of shrub that can be cut.

Next comes the operation of gathering the shrub in the field. This presents many problems even under relatively favorable conditions and no end of them in most of the guayule-bearing country where settlements are few and permanent water often scarce or nonexistent. Experience of the rubber mill operators has shown that laborers for gathering guayule cannot be recruited from the towns or cities, consequently their sole source of labor supply must come from local inhabitants. The task of securing labor and keeping them on the job is one that never ends, especially in recent months since the candelilla wax and other local industries are developing rapidly and, besides paying much better wages, often furnish work that is more to the liking of the average native. Added to these difficulties is the fact that most of the local residents have farms or livestock and periodically take time off to care for them.

After the shrub is gathered and baled, the next problem is that of getting it to the nearest railroad point or to the processing mills. With very few exceptions, roads are entirely unimproved and in many of the guayule areas there are no roads at all. This entails building of many new roads and constant maintenance of roads that are already in existence. Wherever available, trucks are used for hauling; however, wagons and mule teams are a common sight in many sections. The transportation phase of the guayule operations is of such extreme importance that almost daily reports are required from all field camps as to the amount of baled guayule on hand. Thus when traffic in one section is tied up for some cause or other, provision can be made to haul from other localities.

Once the shrub reaches the mill the actual processing of it is more orderly, though even here break-downs occasionally occur and entail delays that are of ever increasing seriousness due to the difficulty of securing repair parts. Labor problems at the processing plants are more or less complicated inasmuch as the common laborers are well organized into powerful unions. The mill operators are required to furnish living quarters and medical facilities and are bound by many stringent rules regarding the hiring, firing, and even promotion of deserving men.

The mill superintendent must be a man of considerably more than average ability. He must not only be an engineer but a good administrator as well. He must be able to tell by the looks and feel of material coming out of the extraction drums whether or not the plant is operating at maximum efficiency, for under ordinary operating conditions, a variation of 1 or 2 percent in the amount of rubber extracted may easily be the difference between a profit and loss in the entire process.

Photographs illustrating the various steps in gathering and processing of guayule may serve to bring out more clearly the many factors that have to be considered and the complex problems that have to be met before the final product of rubber is obtained.